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Nakajima

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(54) **IMAGE FORMING APPARATUS**

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G03G 15/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/0887*** (2013.01); ***G03G 15/0886*** (2013.01); *G03G 15/0877* (2013.01); *G03G 15/0879* (2013.01); *G03G 15/0881* (2013.01); *G03G 2221/1654* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/0877; G03G 15/0879; G03G 15/0881; G03G 15/0886
USPC 399/260
See application file for complete search history.

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(57) **ABSTRACT**

Provided is an image forming apparatus including: a holding member holding a toner container with a discharge port, and a shutter opening/closing the discharge port and having a communicating port communicable with the discharge port; a connecting member forming a toner conveying path, and connecting to/retracting from the shutter in conjunction with an operation of mounting/removing the toner container; a first locking portion movable between a first position to locate the shutter in a non-communicating position and a second position to lock the shutter in a communicating position when the toner container is mounted; and a second locking portion locatable in a position to connect the connecting member to the shutter, and in a position to lock the connecting member in a position where the connecting member is separated away from the shutter when the toner container is mounted.

6 Claims, 13 Drawing Sheets

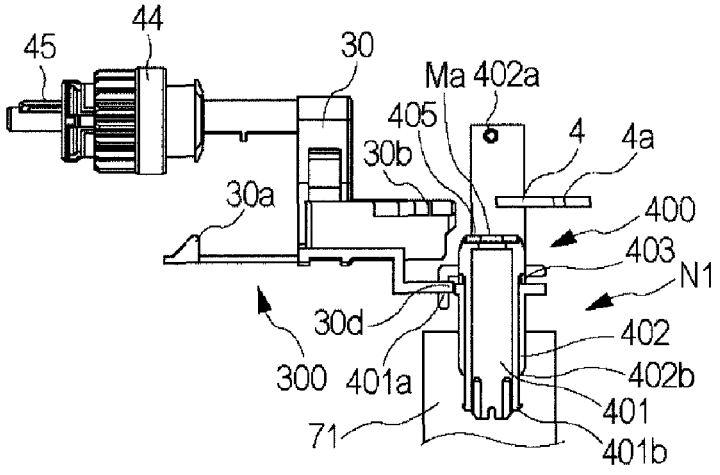

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FIG. 1

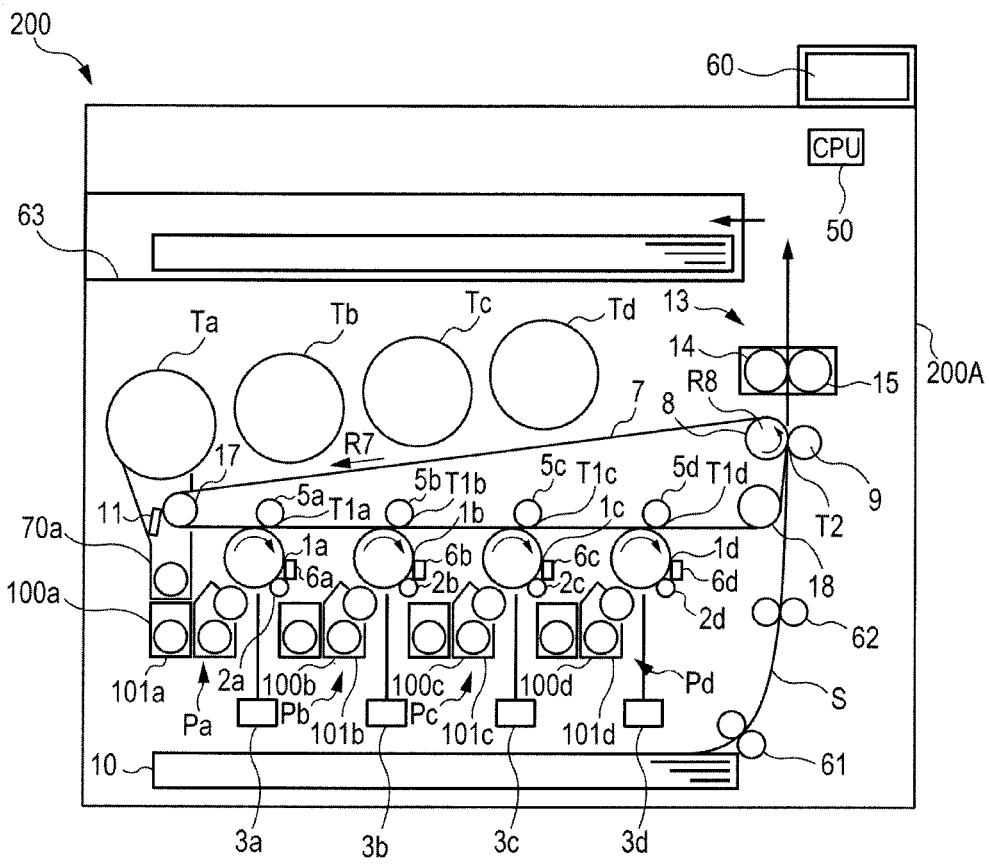
200
60
CPU
50
63
Ta
Tb
Tc
Td
13
14
15
200A
R8
7
8
9
R7
17
5a
T1a
5b
T1b
5c
T1c
5d
T1d
11
1a
1b
1c
1d
T2
70a
6a
6b
6c
6d
18
100a
2a
2b
2c
2d
62
101a
100b
100c
100d
Pd
S
Pa
Pb
Pc
101b
101c
101d
10
61
3a
3b
3c
3d

FIG. 2A

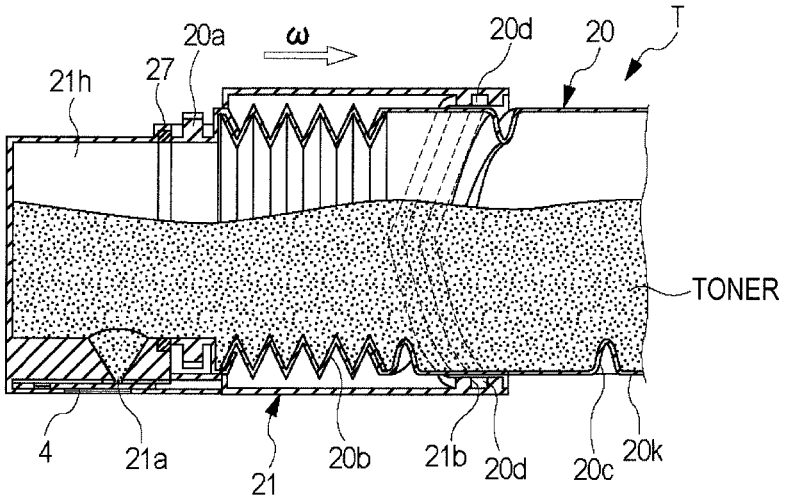
20a
ω
20d
20
T
21h
27
TONER
4
21a
21
20b
21b
20d
20c
20k

FIG. 2B

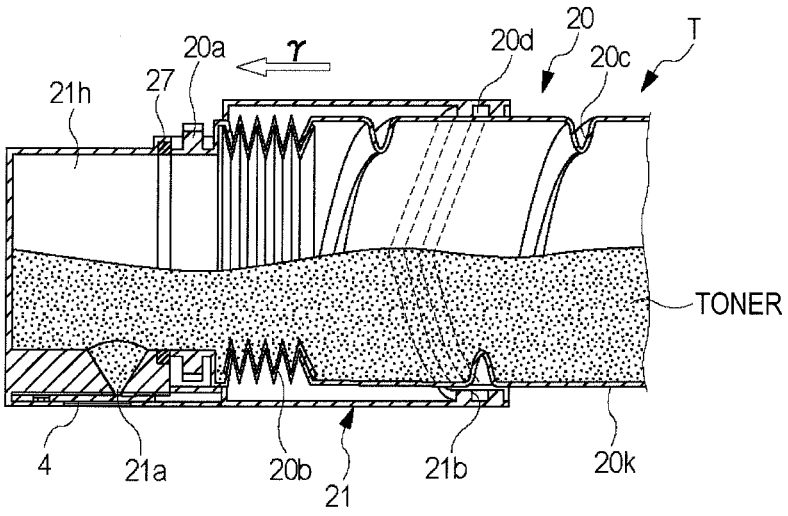
20
20a
γ
20d
20c
T
21h
27
TONER
4
21a
20b
21
21b
20k

FIG. 3

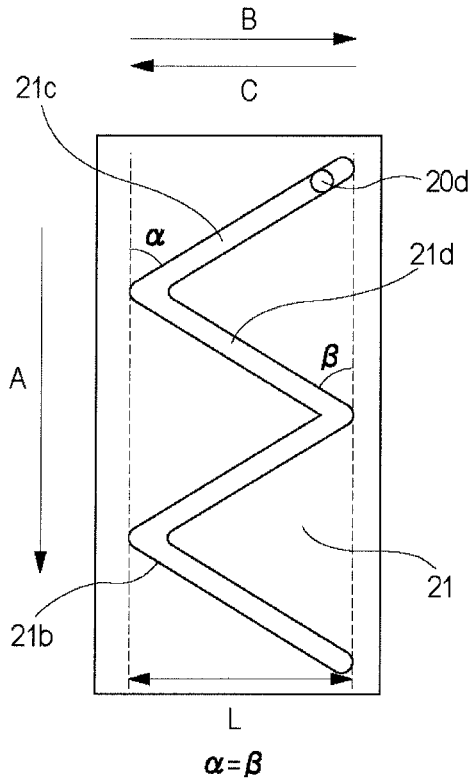

FIG. 4

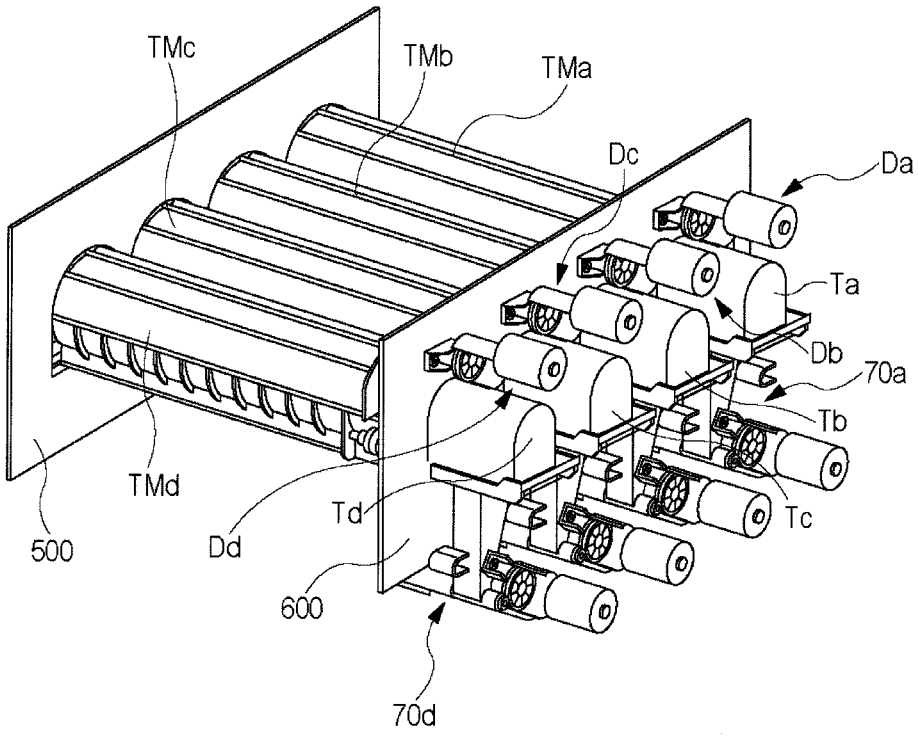

FIG. 5

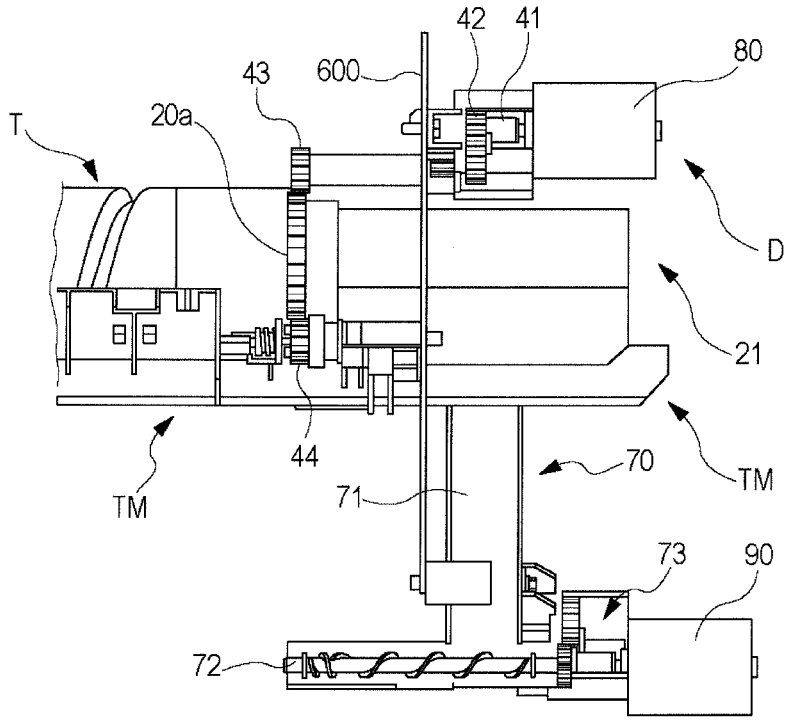

FIG. 6

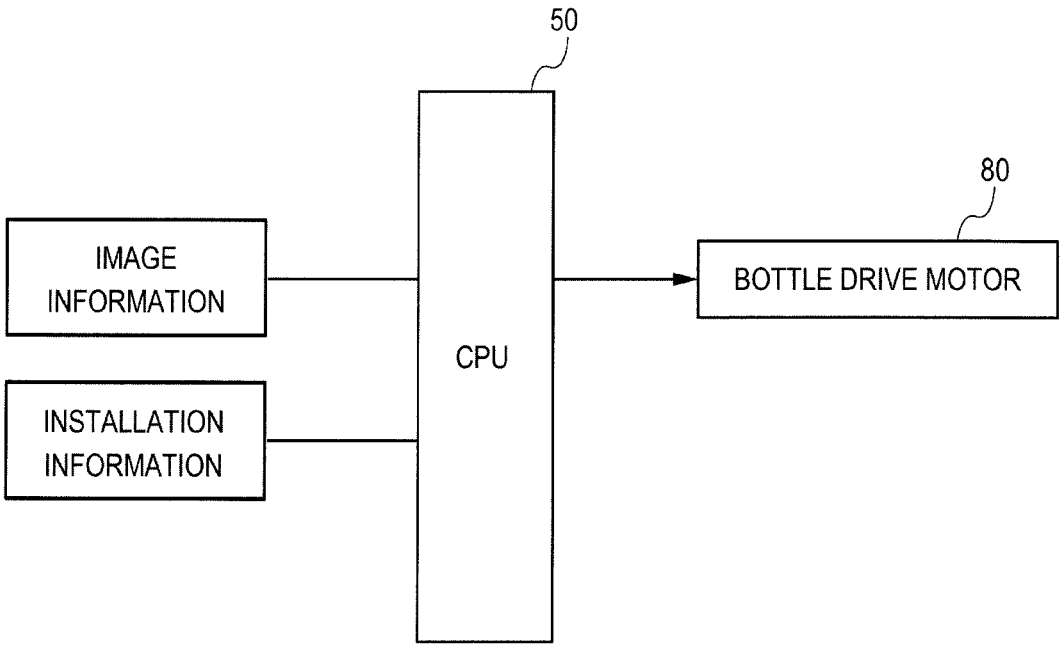
50
80
IMAGE INFORMATION
INSTALLATION INFORMATION
CPU
BOTTLE DRIVE MOTOR

FIG. 7A

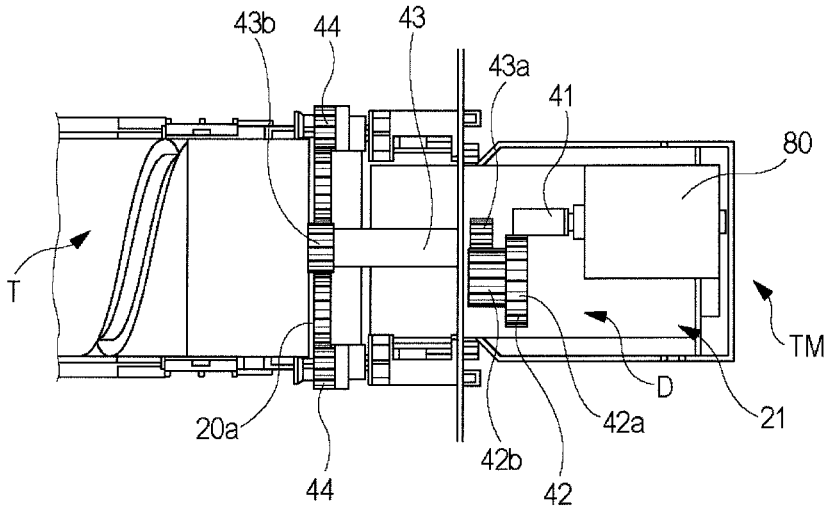
43b
44
43
43a
41
80
T
TM
D
21
42a
20a
42b
42
44

FIG. 7B

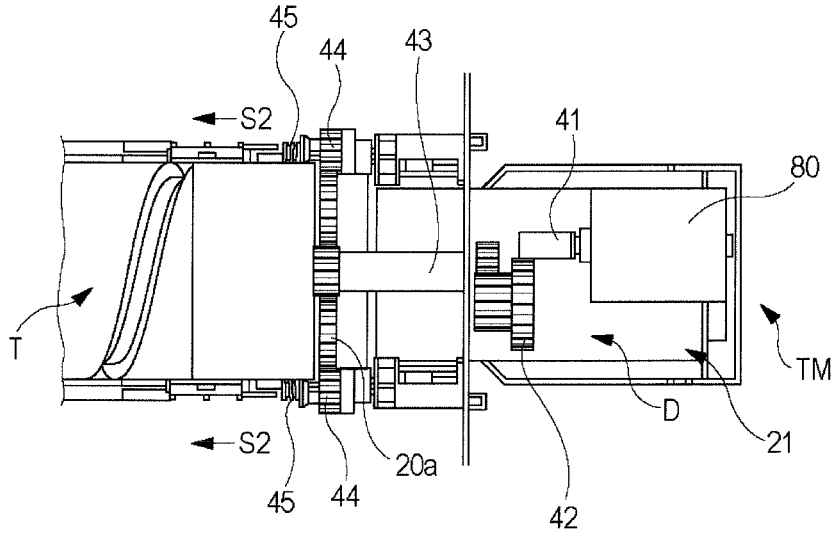
45
44
43
S2
41
80
T
TM
D
21
S2
20a
42
45
44

FIG. 8A

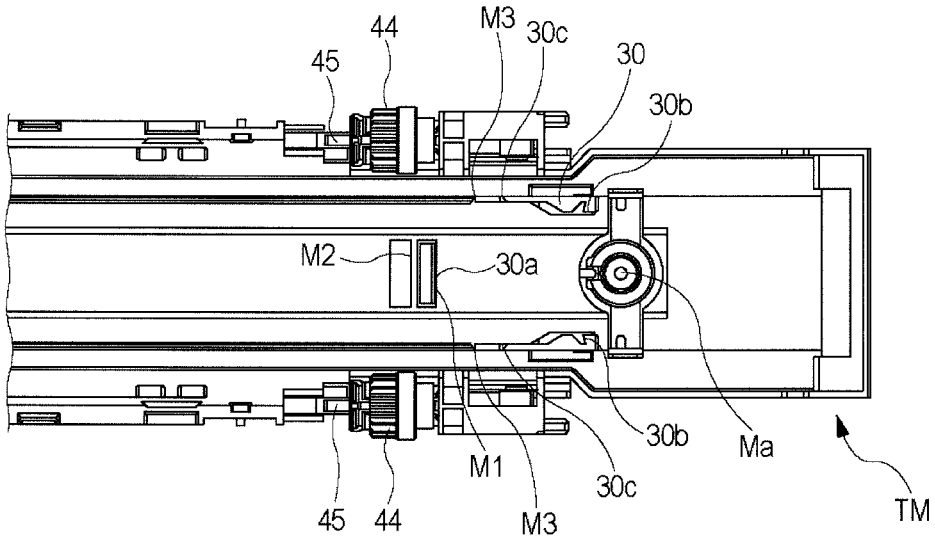
44
M3
30c
30
45
30b
M2
30a
30b
Ma
M1
30c
45
44
M3
TM

FIG. 8B

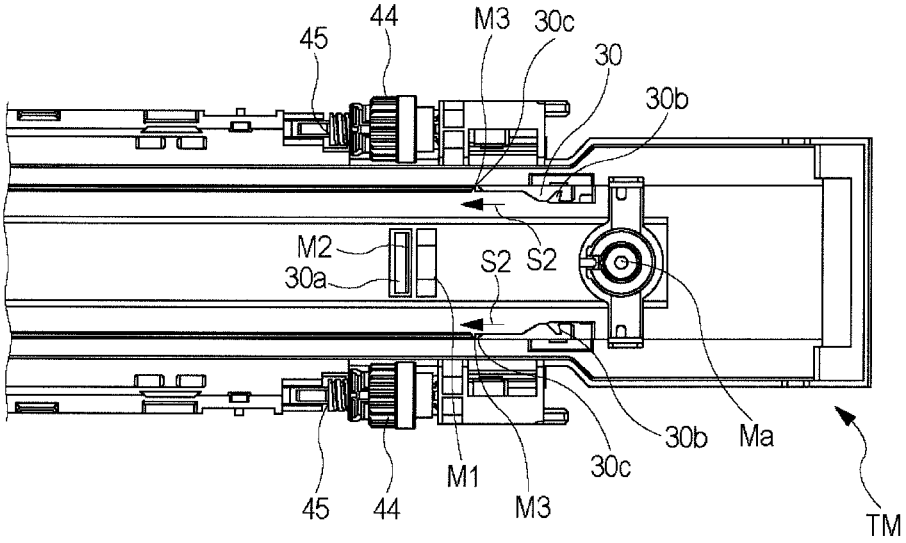
44
M3
30c
45
30
30b
M2
30a
S2
S2
30b
Ma
30c
M1
45
44
M3
TM

FIG. 9A

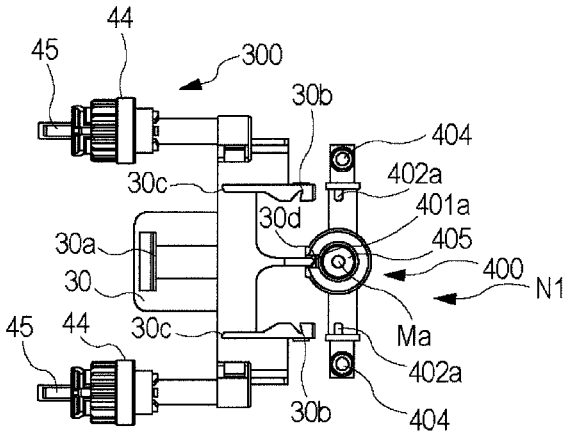

FIG. 9A-b

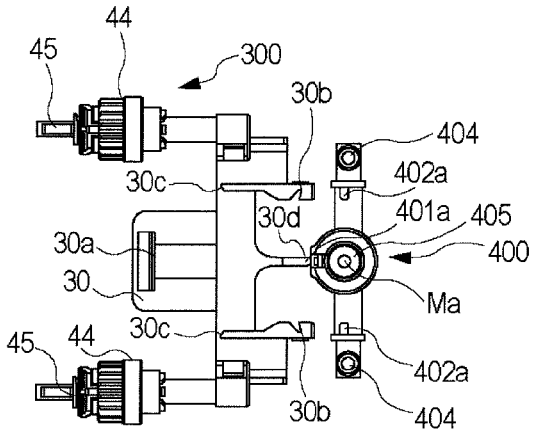

FIG. 9B

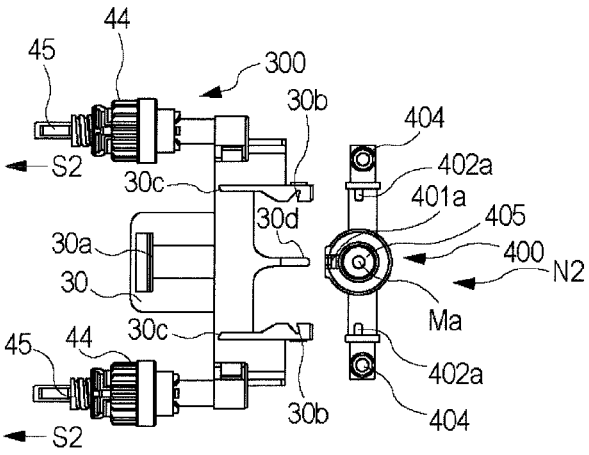

FIG. 10A

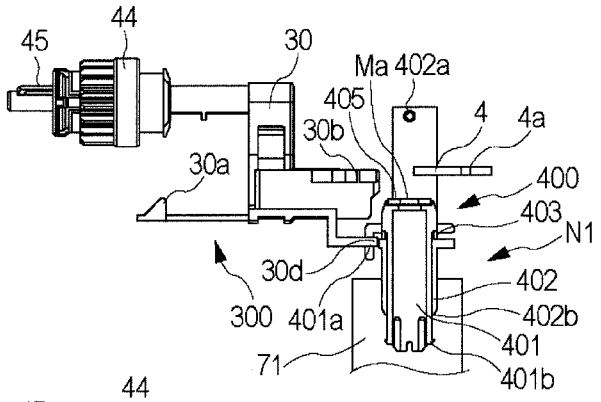

FIG. 10A-b

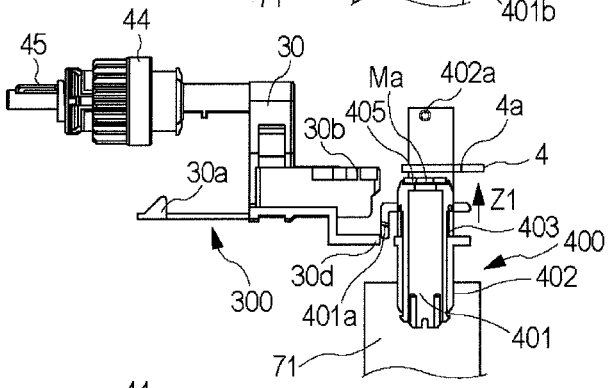

FIG. 10B

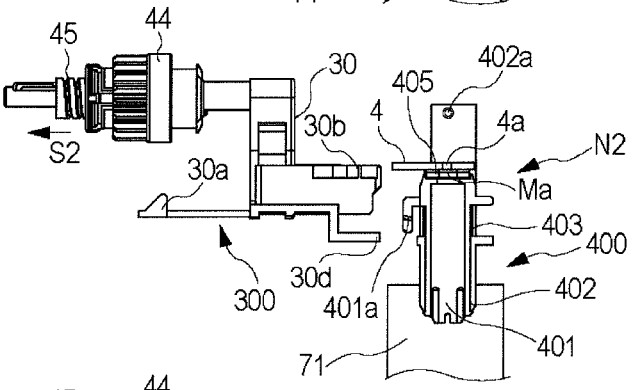

FIG. 10C

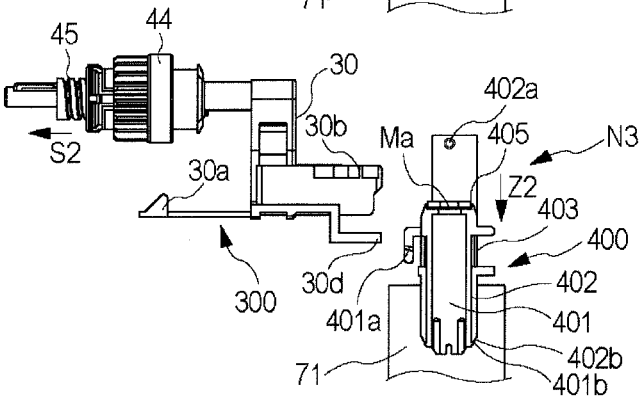

FIG. 11

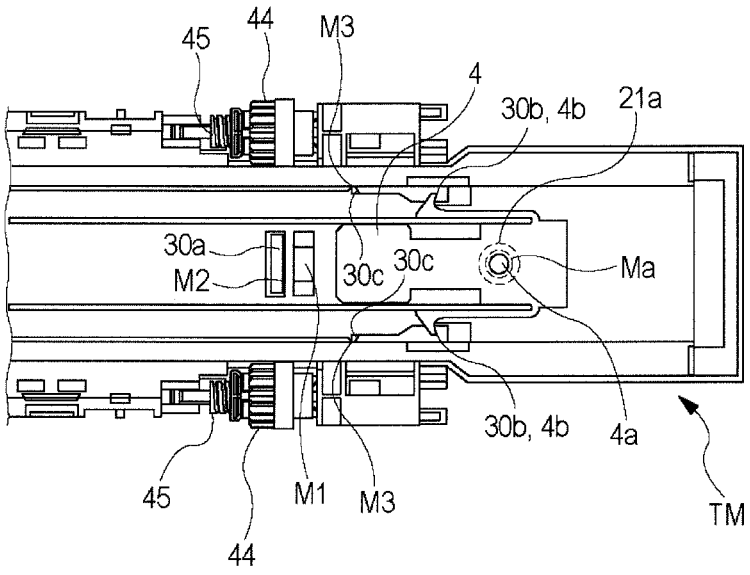

FIG. 12A

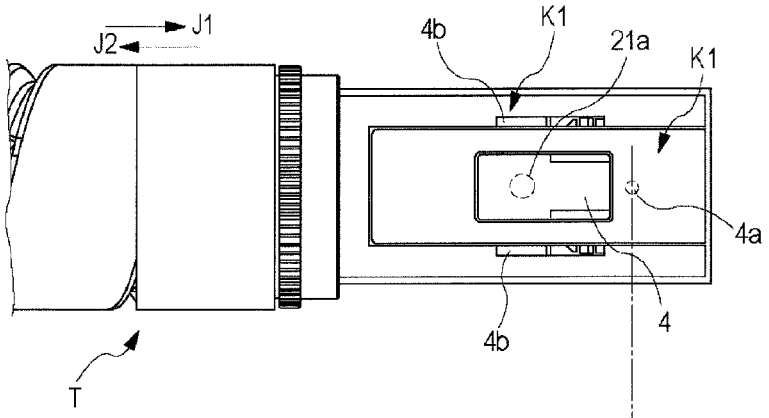

FIG. 12B

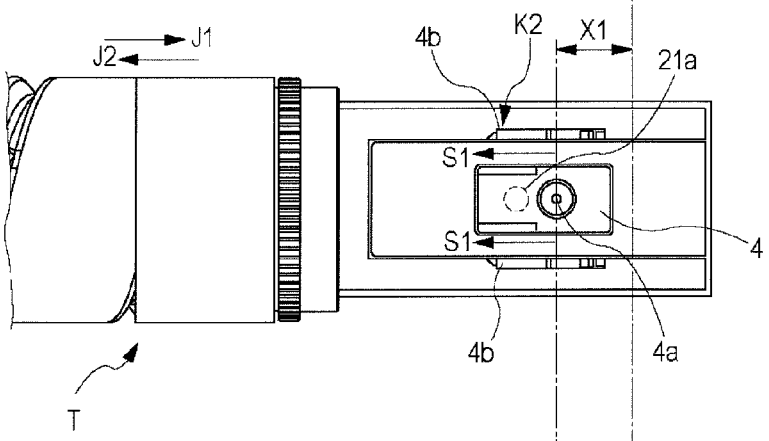

FIG. 12C

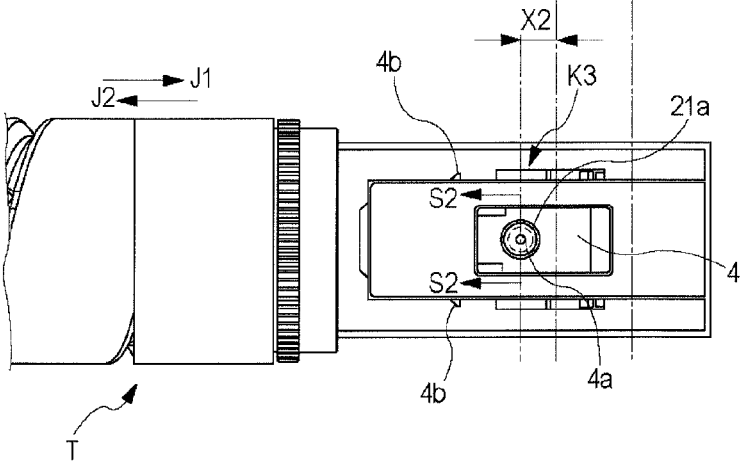

FIG. 13

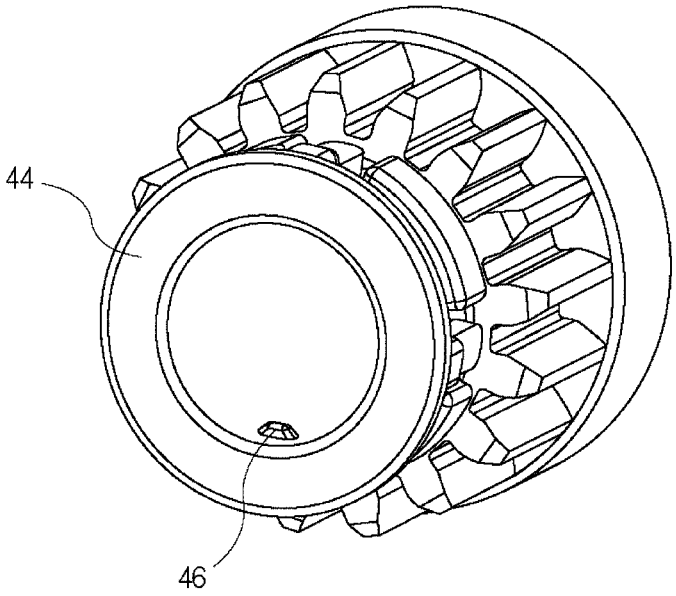

FIG. 14

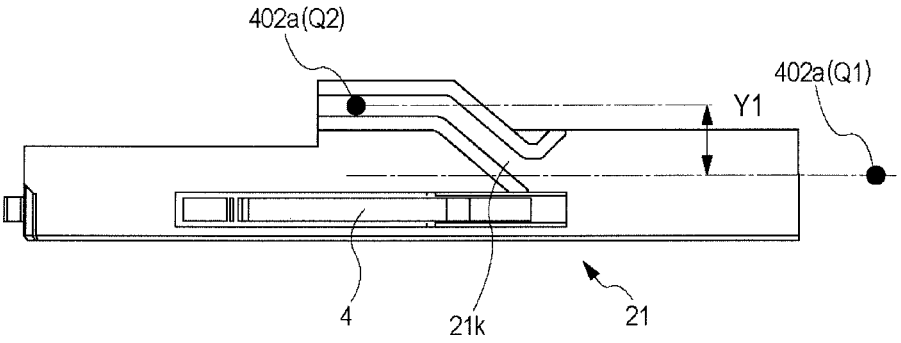

IMAGE FORMING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image forming apparatus including connecting members that are arranged movably to a main body so as to be connectable to and separable from toner containers for containing a toner therein, in conjunction with an operation of mounting and removing the toner containers to enable formation of toner conveying paths.

2. Description of the Related Art

Hitherto, an image forming apparatus is required to be supplied with a toner along with the consumption of the toner. Therefore, the image forming apparatus includes a removable toner container. The toner container generally includes a shutter capable of opening and closing a discharge port so as not to leak the toner through the toner discharge port. The shutter is arranged so as to be opened in conjunction with an operation of mounting the toner container when the toner container is mounted to an apparatus main body.

As described in Japanese Patent Application Laid-Open No. 2013-15826, a toner container including a stretchable pump portion has been proposed hitherto. The toner container discharges the toner by a pressure generated when the pump portion is stretched and compressed.

An apparatus described in Japanese Patent Application Laid-Open No. 2013-15826 has the following configuration for preventing the toner discharged through the discharge port of the toner container by the pressure of the pump portion from leaking from the discharge port to spill out in the apparatus. Specifically, the apparatus includes a connecting portion that moves so as to be brought into contact with and separated away from the toner discharge port in conjunction with an operation of mounting and removing the toner container so that the discharge port of the toner container can be connected when the toner container is mounted. A toner conveying path capable of bringing the toner container and the toner receiving portion into contact with each other and separating the toner container and the toner receiving portion away from each other is arranged to enhance sealing properties.

SUMMARY OF THE INVENTION

According to Japanese Patent Application Laid-Open No. 2013-15826, the opening/closing operation of the shutter and the contacting/separating operation of the connecting portion are performed in conjunction with the operation of mounting and removing the toner container. In Japanese Patent Application Laid-Open No. 2013-15826, it is conceivable to ship the main body, in which the toner container is mounted, to be packed in the same package, for the purposes of reducing a packing size of the main body and saving packing materials for the toner container.

With the above-mentioned configuration, in the case that the toner container and the main body are packed in the same package, the shutter of the toner container is opened so that the toner container and the toner receiving portion are disadvantageously brought into communication with each other. Therefore, the toner flows from the toner container through the discharge port into the toner receiving portion located downstream during shipping. As a result, there is a fear of causing fluctuations in image density.

Therefore, the following configuration is desired. Specifically, for normal use, the shutter is opened in conjunction with the mounting of the toner container. When the toner container and the main body are packed in the same package and shipped, the shutter is not opened even when the toner container is mounted. To meet the requirements described above, the following configuration is conceived. When shipping the apparatus, a locking member is located in a position in which the shutter is not opened even when the toner container is mounted. When normally using, the locking member is moved to a normal position (in which the shutter is opened when the toner container is mounted).

If the above-mentioned configuration is adopted, however, the connecting portion is subjected to a shear force generated by a sliding operation of the shutter. As a result, there is a fear in that the sealing properties for the toner are impaired. Further, in a case where a sealing member having flexibility is used as the connecting portion, there is a fear in that the sealing properties for the toner are reduced due to deformation of the sealing member. Any configuration including the connecting portion to be connected to the toner container in conjunction with the mounting of the toner container has the same problems even if the toner container does not use the pump function as described in Japanese Patent Application Laid-Open No. 2013-15826.

The present invention has been made in view of the above-mentioned circumstances. Specifically, the present invention provides an image forming apparatus including a connecting portion that is connectable to a discharge port of a toner container in conjunction with an operation of mounting the toner container, in which the connecting portion can be separated away from the toner container when the toner container is mounted.

In order to achieve the above-mentioned object, according to one embodiment of the present invention, there is provided an image forming apparatus, including: an apparatus main body; a holding member configured to hold a toner container containing a toner and provided removably and mountably to the apparatus main body, wherein the toner container has a discharge port through which the toner is discharged and a shutter configured to be movable with respect to the toner container to open and close the discharge port, and wherein the shutter has a communicating port communicable with the discharge port and is configured to move relative to the toner container to open and close the discharge port; a toner receiving portion configured to receive the toner discharged from the toner container; a connecting member movably provided to the apparatus main body and enabling to form a toner conveying path between the toner container and the toner receiving portion, wherein the connecting member is configured to be movable, in conjunction with an operation of mounting and removing the toner container, between a position in which the connecting member connects to the shutter and a position in which the connecting member retracts from the shutter; a first locking portion movably provided to the apparatus main and lockable to the shutter, wherein, when the toner container is mounted, the first locking portion is provided movably between a first position to allow the shutter to locate in a non-communicating position in which the communicating port and the discharge port are not brought into communication with each other, and a second position to lock the shutter in a communicating position in which the communicating port and the discharge port are brought into communication with each other; and a second locking portion movably provided to the apparatus main body and lockable to the connecting member, wherein, when the toner container is mounted, the second locking portion is provided so as to be locatable in a position to allow the connecting

member and the shutter to connect to each other, and in a position to lock the connecting member in a position in which the connecting member and the shutter are separated away from each other.

According to the one embodiment of the present invention, it is possible to provide the image forming apparatus including the connecting portion that is connectable to the discharge port of the toner container in conjunction with the operation of mounting the toner container, in which the connecting portion can be separated away from the toner container when the toner container is mounted.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view illustrating an operation of a color image forming apparatus according to a first embodiment of the present invention.

FIGS. **2**A and **2**B are sectional views of a toner container according to the first embodiment.

FIG. **3** is a partial enlarged view of the toner container according to the first embodiment.

FIG. **4** is a top perspective view in an apparatus according to the first embodiment.

FIG. **5** is a right side view of the apparatus according to the first embodiment.

FIG. **6** is a control block diagram of the first embodiment.

FIGS. **7**A and **7**B are top views in the apparatus according to the first embodiment.

FIGS. **8**A and **8**B are top views in the apparatus according to the first embodiment (without the toner container).

FIGS. **9**A, **9**A-b, and **9**B are top views of a connecting device according to the first embodiment.

FIGS. **10**A, **10**A-b, **10**B, and **10**C are sectional views of the connecting device according to the first embodiment.

FIG. **11** is a top view in the apparatus according to the first embodiment (after the completion of installation of the toner container).

FIGS. **12**A, **12**B, and **12**C are diagrams illustrating a sliding transition of the shutter according to the first embodiment.

FIG. **13** is a perspective view of a slide gear according to the first embodiment.

FIG. **14** is a partial enlarged view of the toner container according to the first embodiment.

DESCRIPTION OF THE EMBODIMENTS

Preferred embodiments of the present invention will now be described in detail in accordance with the accompanying drawings.

Embodiments

Image Forming Apparatus

An image forming apparatus **200** according to a first embodiment of the present invention is described. FIG. **1** is a sectional view of an electrophotographic color image forming apparatus, specifically, the image forming apparatus **200** is an image forming apparatus of what is called an intermediate transfer tandem type in which four-color image forming portions are arrayed above an intermediate transfer belt **7**. The intermediate transfer tandem type is excellent in productivity and adaptable to conveyance of various media, and hence has become mainstream in recent years. A direction perpendicular to the drawing sheet of FIG. **1** corresponds to a near-and-far direction of the image forming apparatus.

<Conveying Process of Recording Material>

Recording materials S are received by being stacked in a storage **10**, and are fed at appropriate timings with respect to image formation by feed rollers **61** employing a friction separation system. The recording materials S paid out by the feed rollers **61** are conveyed to registration rollers **62** through a conveying path. After skew feed correction and timing control by the registration rollers **62**, the recording materials S are sent to a secondary transfer portion T**2**. The secondary transfer portion T**2** is a transfer nip portion formed of an inner secondary transfer roller **8** and an outer secondary transfer roller **9** facing each other. The secondary transfer portion T**2** applies a predetermined pressing force and a predetermined electrostatic load bias so as to attract toner images onto the recording materials S.

<Image Forming Portion>

A process of forming images to be conveyed to the secondary transfer portion T**2** at the same timings with the recording materials S that are conveyed as described above by the conveying process until the secondary transfer portion T**2** is described. Image forming portions Pa, Pb, Pc, and Pd mainly and respectively include photosensitive drums **1***a*, **1***b*, **1***c*, and **1***d* that serve as image bearing members, charging devices **2***a*, **2***b*, **2***c*, and **2***d*, exposure devices **3***a*, **3***b*, **3***c*, and **3***d*, developing devices **100***a*, **100***b*, **100***c*, and **100***d*, and developing containers **101***a*, **101***b*, **101***c*, and **101***d*. Further, the image forming portions Pa to Pd include primary transfer rollers **5***a*, **5***b*, **5***c*, and **5***d*, photosensitive member cleaners **6***a*, **6***b*, **6***c*, and **6***d*, and the like.

<Image Forming Process>

Surfaces of the photosensitive drums **1***a* to **1***d* are uniformly charged in advance respectively by the charging devices **2***a* to **2***d*. The photosensitive drums **1***a* to **1***d* are rotationally driven by a development driving device (not shown). The photosensitive drums **1***a* to **1***d* are exposed by the exposure devices **3***a* to **3***d* based on signals of image information to form electrostatic latent images thereon.

Next, the electrostatic latent images formed respectively on the photosensitive drums **1***a* to **1***d* are developed by the developing devices **100***a* to **100***d* and appear as toner images. Then, a predetermined pressing force and a predetermined transfer bias are applied by the primary transfer rollers **5***a* to **5***d*. With this, the toner images are transferred onto the intermediate transfer belt **7**. Lastly, untransferred residual toner slightly remaining on the photosensitive drums **1***a* to **1***d* is collected by the photosensitive member cleaners **6***a* to **6***d*, to thereby prepare for subsequent image forming processes again.

When a toner amount in each of the developing devices **100***a* to **100***d* decreases, a toner is supplied from corresponding one of containers (also referred to as "toner containers") Ta, Tb, Tc, and Td (Tb, Tc, and Td have the same shape as that of the toner container Ta). The containers Ta to Td as the toner containers are arranged so as to be mountable to and removable from an apparatus main body.

Supply devices **70***a*, **70***b*, **70***c*, and **70***d* (the supply devices **70***b*, **70***c*, and **70***d* have the same shape as that of the supply device **70***a*, therefore the supply devices are collectively denoted by the reference numeral **70**; the illustration of the supply devices **70***b* to **70***d* is omitted in FIG. **1**; and each suffix corresponds to that for the development device) are

driven in synchronization with the corresponding developing devices **100***a* to **100***d* so as to supply the toner. A supply operation is described later.

As illustrated in FIG. **4**, the containers Ta to Td (see FIG. **1**) are received and held respectively by holding members TMa, TMb, TMc, and TMd bridged between a front plate **500** and a rear plate **600**. The holding members TMa to TMd are bridged independently of each other between the front plate **500** and the rear plate **600**. A development driving device is fastened and installed onto the rear plate **600**.

In the case illustrated in FIG. **1**, the image forming portions Pa to Pd described above are four image forming portions respectively corresponding to yellow (Y), magenta (M), cyan (C), and black (Bk). However, colors are not limited to four colors, and order is not limited to the stated order. Further, the developing containers **101***a* to **101***d* contain in advance a two-component developer obtained by mixing a non-magnetic toner and a magnetic carrier. In some cases, however, a single-component developer containing only one of a magnetic toner and the non-magnetic toner may be used. This embodiment describes a case where the two-component developer (initial agent) is contained in the developing containers **101***a* to **101***d*.

With reference to FIG. **1**, the intermediate transfer belt **7** is described. The intermediate transfer belt **7** is installed to an intermediate transfer belt frame (not shown). The intermediate transfer belt **7** is stretched around the inner secondary transfer roller **8**, a tension roller **17**, and an upstream secondary transfer roller **18**, which serve as a drive transmission unit for the intermediate transfer belt **7**. When the inner secondary transfer roller **8** is driven in a direction indicated by an arrow R**8**, the intermediate transfer belt **7** is driven in a direction indicated by an arrow R**7**. The intermediate transfer belt **7** is an endless belt. The image forming processes of the colors of Y, M, C, and Bk are executed parallel to each other respectively by the image forming portions Pa to Pd of the respective colors at such timings that the toner images are sequentially superimposed on preceding toner images of upstream colors, which are subjected to primary transfer onto the intermediate transfer belt **7**. As a result, a full-color toner image is formed on the intermediate transfer belt **7**, and finally conveyed to the secondary transfer portion T**2**. Note that, untransferred residual toner remaining even after passage through the secondary transfer portion T**2** is collected by a transfer cleaning device **11**.

<Process after Secondary Transfer>

By the conveying process and the image forming processes described above, the full-color toner images and the recording materials S reach the secondary transfer portion T**2** at the same timings. Then, secondary transfer is performed. After that, the recording materials S are conveyed into a fixing device **13**. In the fixing device **13**, a fixing nip formed of opposed rollers **14** and **15** applies predetermined heat and pressure to the recording materials S passing therethrough. With this, the toner images are molten and fixed onto the recording materials S.

Thus, the fixing device **13** includes a heater as a heat source, and is controlled to constantly maintain an optimum temperature. After the images are fixed as described above, route selection as to whether the recording materials S are delivered onto a delivery tray **63** or conveyed to a reverse conveying device (not shown) in a case where duplex image formation is needed is performed.

<Container T>

Next, the containers Ta, Tb, Tc, and Td (hereinafter collectively denoted by the reference symbol "T" because the containers have the same shape) held by the holding members TMa, TMb, TMc, and TMd (hereinafter collectively denoted by the reference symbol "TM" because the holding members have the same shape) are described with reference to FIGS. **2**A and **2**B.

As illustrated in FIG. **2**A, the container T configured to contain toner includes a toner containing portion **20** that is formed into a hollow cylindrical shape and has an interior space for containing the toner (indicated as "toner" in FIG. **2**A). Further, the container T includes a flange portion **21** (also referred to as unrotatable portion) formed on one end side in a longitudinal direction of the toner containing portion **20** (developer conveying direction). Further, the toner containing portion **20** is configured to be rotated relative to the flange portion **21**.

As illustrated in FIG. **2**B, the flange portion **21** includes a hollow discharge portion **21***h* configured to temporarily pool the toner conveyed from an inside of the toner containing portion **20**. Through a bottom portion of the discharge portion **21***h*, there is formed a small discharge port **21***a* configured to allow the toner to be discharged to an outside of the container T, in other words, to supply the toner to the supply device **70** (see FIG. **1**). Further, in an inside of the flange portion **21**, there is formed a shutter **4** configured to open and close the discharge port **21***a*. The shutter **4** includes a communicating port **4***a* communicable with the toner discharge port **21***a* formed through the container T. The shutter **4** is slid with respect to the container T so as to open and close the discharge port **21***a*. Movement of the shutter **4** is described below.

A pump portion **20***b* of this embodiment functions as an air intake/exhaust mechanism configured to alternately perform an air intake operation and an air exhaust operation through the discharge port **21***a*. As illustrated in FIG. **2**B, the pump portion **20***b* is interposed between the discharge portion **21***h* and a cylindrical portion **20***k*, and is connected and fixed to the cylindrical portion **20***k*. In other words, the pump portion **20***b* is configured to be rotated integrally with the cylindrical portion **20***k*. Further, the pump portion **20***b* of this embodiment is configured to contain toner therein.

In this embodiment, a resin capacity-variable pump (bellows pump) that is variable in capacity along with reciprocation (arrow ω and arrow γ indicate moving directions of the pump portion **20***b*) is employed as the pump portion **20***b*. Specifically, as illustrated in FIGS. **2**A and **2**B, the bellows pump, which includes a plurality of "peak" portions and a plurality of "valley" portions that are regularly and alternately formed, is employed.

As illustrated in FIG. **2**B, the pump portion **20***b* is fixed to be rotated relative to the discharge portion **21***h* under a state in which a ring-shaped sealing member **27** arranged along an inner surface of the flange portion **21** is compressed by an end portion on the discharge portion **21***h* side of the pump portion **20***b*.

The container T includes a gear portion **20***a*. This gear portion **20***a* is fixed to one end side in a longitudinal direction of the pump portion **20***b*. In other words, the gear portion **20***a*, the pump portion **20***b*, and the cylindrical portion **20***k* are configured to be rotated integrally with each other.

With this configuration, a rotational driving force input to the gear portion **20***a* is transmitted to the cylindrical portion **20***k* (conveying portion **20***c*) through intermediation of the pump portion **20***b*.

A groove portion **21***b* that functions as a driven portion, into which a cam projection **20***d* is fitted, is formed over the entire inner peripheral surface of the flange portion **21**A. This groove portion **21***b* is described with reference to FIG.

3. In FIG. 3, an arrow A indicates a rotation direction of the cylindrical portion 20*k* (moving direction of the cam projection 20*d*), an arrow B indicates a stretching direction of the pump portion 20*b*, and an arrow C indicates a compression direction of the pump portion 20*b*.

Further, an angle α is formed between the rotation direction A of the cylindrical portion 20*k* and a groove part 21*c*, and an angle μ is formed between the rotation direction A and a groove part 21*d*. Still further, the groove portion 21*b* has an amplitude (stretching/compression length of the pump portion 20*b*) L in the stretching and compression directions B and C of the pump portion 20*b*.

Specifically, as illustrated in FIG. 3, which is a developed view of the groove portion 21*b*, in the groove portion 21*b*, the groove parts 21*c* each inclined from the cylindrical portion 20*k* to the discharge portion 21*h* and the groove parts 21*d* each inclined from the discharge portion 21*h* to the cylindrical portion 20*k* are coupled alternately to each other. In this embodiment, α=μ is established.

Thus, in this embodiment, the cam projection 20*d* and the groove portion 21*b* function as the drive transmission mechanism for the pump portion 20*b*. In other words, the cam projection 20*d* and the groove portion 21*b* function as a mechanism configured to convert the rotational driving force received by the gear portion 20*a* to a force in such a direction that the pump portion 20*b* is reciprocated (rotation axis direction of the cylindrical portion 20*k*), and to transmit this force to the pump portion 20*b*.

<Supply Configuration>

Next, a supply configuration for discharging the toner from the container T is described with reference to FIGS. 4 to 6. FIG. 4 is a top perspective view of interior of an apparatus main body 200A, and FIG. 5 is a right side view of the interior of the apparatus main body 200A. The container T is received removably by the holding member TM that is bridged between the front plate 500 and the rear plate 600.

Driving devices Da, Db, Dc, and Dd (hereinafter collectively denoted by the reference symbol "D" because the driving devices Da, Db, Dc, and Dd have the same shape) (supply driving devices) are installed onto the rear plate 600. Each of the driving devices D (see FIGS. 5, 7A, and 7B), functioning as a "driving unit" for transmitting a driving force to the container T, includes a motor 80 (bottle drive motor), and a gear 41, a gear 42 and a gear member 43 that are configured to reduce and transmit a driving force generated by the motor 80. The gear 41 is mounted to a shaft of the motor 80. A first stage 42*a* of the gear 42 having two stages is meshed with the gear 41. A gear 43*a* of the gear member 43 is meshed with a second stage 42*b* of the gear 42 having the two stages. A gear portion 20*a* arranged on an outer circumference of the container T is meshed with a gear 43*b* of the gear member 43.

With the above-mentioned configuration, the driving force generated by the motor 80 is transmitted to the gear 41, the gear 42, the gear member 43, and the gear portion 20*a*. The container T is driven by the driving of the gear portion 20*a*. Thus, an operation of supplying the toner to the container T can be performed.

FIG. 6 is a block diagram illustrating how a CPU performs control. As illustrated in FIG. 6, when receiving image information of the recording materials S to be output and installation information, the CPU 50 sends a rotation timing and a rotation time period of the motor 80. With this, a predetermined amount of toner is stably supplied from the container T into the supply device 70.

As illustrated in FIG. 5, the supply device 70 includes a containing portion 71 serving as a toner receiving portion, a conveying motor 90, and a screw 72 coupled to and driven by a gear train 73. The containing portion 71 is configured to contain toner therein. The conveying motor 90 is rotated in synchronization with the development driving device (not shown). With this, the toner conveyed into the supply device 70 is conveyed to the developing device 100 that closely contacts with the containing portion 71, and the image forming operation is performed.

At the time of transportation or shipping of the image forming apparatus 200, the developing devices 100 are installed inside the apparatus main body 200A to be packed in the same package. At this time, each of the developing devices 100 and the containing portion 71 are connected so as to be held in close contact with each other to form a toner path. The developer (initial agent) is contained in the developing device 100. Therefore, a closed region is on a side of the containing portion 71 (downstream side of the containing portion 71) which is connected to the developing device 100. An open region is on an upstream side of the containing portion 71.

<Release of Sealing of Container T>

An operation of releasing sealing of the container T, which is performed at the time of installation, is described.

In this embodiment, even in a state in which the containers T are mounted inside the apparatus main body 200A at the time of shipping of the image forming apparatus 200, the discharge port 21*a* of each of the containers T is closed by the shutter 4. Therefore, the toner is not supplied from (the toner does not leak from) the container T. On the other hand, in normal use for performing image formation, the shutter 4 opens in conjunction with the operation of mounting the container T.

In order to realize the above-mentioned configuration, a release device 300 is arranged. When the container T is mounted in the apparatus main body 200A, the release device 300 releases a state in which the discharge port 21*a* of the container T is closed by the shutter 4 to achieve a state (sealing released state) in which the shutter 4 is opened in conjunction with the operation of mounting the container T.

The release device 300 is movable from a state where the shutter 4 and the connecting device 400 (FIGS. 10A, 10A-b, 10B, and 10C) are separated away from each other to a state where the shutter 4 and the connecting device 400 are connectable to each other when the container T is mounted in the apparatus main body 200A. Now, the operation of releasing the sealing of the container T, which is performed at the time of installation, is described further in detail with reference to FIGS. 7A to 14.

In this embodiment, a position of a slider 30 of the release device 300 (see FIGS. 9A, 9A-b, and 9B) is set different in normal use from that at the time of shipping. By controlling a sliding amount of the shutter 4 when the container T is mounted, the sealing of the container T is realized. By the movement of the connecting device 400 (see FIGS. 10A to 10C) away from the container T, the inside of the containing portion 71 is kept at an atmospheric pressure.

FIGS. 7A and 7B are top views illustrating a state in which the container T is installed inside the apparatus main body 200A. FIGS. 8A and 8B are top views with the omission of the container T and the driving device D from FIGS. 7A and 7B. FIGS. 9A, 9A-b, and 9B are top views of the release device 300 and the connecting device 400, and FIGS. 10A, 10A-b, 10B, and 10C are sectional views of the release device 300 and the connecting device 400. FIG. 11 is a top view illustrating a state in which the shutter 4 is

mounted in the state illustrated in FIGS. **8**A and **8**B. FIGS. **7**A, **8**A, **9**A, and **10**A are respectively detailed views of the portions in the same state. FIGS. **7**B, **8**B, **9**B, and **10**B are respectively detailed views of the portions in the same state. FIGS. **9**A-b and **10**A-b are detailed views of the portions in the same state and illustrate a transitional state from the state illustrated in FIG. **9**A to the state illustrated in FIG. **9**B and from the state illustrated in FIG. **10**A to the state illustrated in FIG. **10**B, respectively. FIGS. **12**A to **12**C are back surface views of the container T. FIG. **14** is a detailed view illustrating a state in which a lifting member **402** is moved up and down relative to a lifting groove **21***k* arranged to the flange portion **21**. An operation thereof is described later.

The release device **300** is now described. In this embodiment, the position of the shutter **4** to be regulated inside the main body at the time of shipping and that in normal use are set different from each other so that the sliding amount of the shutter **4** differs when mounting the container T. In this embodiment, stop portions **30***b* functioning as first locking portions, which can be locked to the shutter **4**, are movable relative to the main body. In this manner, the above-mentioned configuration is realized.

FIG. **7**A corresponds to a top view before a claw **30***a* (see FIGS. **9**A, **9**A-b, and **9**B) of the release device **300** for the shutter **4** is moved, and FIG. **7**B corresponds to a top view after the claw **30***a* (see FIGS. **8**A, **8**B, **9**A, **9**A-b, and **9**B) of the release device **300** for the shutter **4** is moved in a direction indicated by an arrow S**2**. The release device **300** for the shutter **4** includes driving slide gears **44** functioning as gears for converting rotational driving into sliding movement and worm gears **45** that move in a sliding manner respectively inside the slide gears **44** along with a rotating operation of the slide gears **44**.

The gear **43***b* of the gear member **43** that functions as a driving input unit for the driving device D and the gear portion **20***a* that functions as a driving input unit for the container T are located in the same position in a direction in which the container T is inserted into or separated away from the apparatus main body **200**A. Similarly, the gear **43***b* of the gear member **43** and the slide gears **44**, which function as a driving input unit for the release device **300**, are located in the same position in the direction in which the container T is inserted into or separated away from the apparatus main body **200**A. By the driving force transmitted from the driving device D that transmits the driving force to the container T, an operation of discharging the toner from the container T is performed.

The release device **300** is driven by the driving force transmitted from the driving device D to the container T. By the driving of the release device **300**, the sealing by the shutter **4** is released. Further, the state of the connecting device **400** transitions from the separated state to the connected state with respect to the container T by the driving force transmitted from the driving device D to the container T. The transition of the state of the connecting device **400** is described later.

In a process of a transition from the state illustrated in FIG. **7**A to that illustrated in FIG. **7**B, when the gear portion **20***a* of the container T rotates, the slide gears **44** that are brought into meshing engagement with the gear portion **20***a* also rotate. Along with the rotation of the slide gears **44**, the worm gears **45** respectively move inside the slide gears **44** in the direction indicated by the arrow S**2**. By the movement of the worm gears **45** in the direction indicated by the arrow S**2**, the claw **30***a* for releasing the sealing by the shutter **4** moves in the direction indicated by the arrow S**2**.

FIG. **8**A corresponds to a top view before the movement of the claw **30***a* (see FIGS. **9**A, **9**A-b, and **9**B) of the release device **300** for the shutter **4**. FIG. **8**B corresponds to a top view after the claw **30***a* (see FIGS. **9**A, **9**A-b, and **9**B) of the release device **300** for the shutter **4** is moved in a direction indicated by the arrow S**2**. The release device **300** for the shutter **4** includes the claw **30***a*. The holding member TM includes an opening Ma, a fixing portion M**1**, and a fixing portion M**2** in the stated order in the direction indicated by the arrow S**2**. The claw **30***a* is inserted in the fixing portion M**1** in FIG. **8**A, whereas the claw **30***a* is inserted in the fixing portion M**2** in FIG. **8**B.

FIG. **9**A corresponds to a top view before the claw **30***a* of the release device **300** for the shutter **4** is moved. FIG. **9**B corresponds to a top view after the claw **30***a* of the release device **300** for the shutter **4** is moved in the direction indicated by the arrow S**2**. It is understood that the claw **30***a* is moved in the direction indicated by the arrow S**2** along with the movement of the worm gears **45** in the direction indicated by the arrow S**2**. The release device **300** includes the slider **30**. The slider **30** includes the single claw **30***a* and the two stop portions **30***b* as the first locking portions. A restricting portion **30***c* is formed on each of the stop portions **30***b*. FIGS. **10**A, **10**A-b, **10**B, and **10**C correspond to sectional views of FIGS. **9**A, **9**A-b, and **9**B.

<Connecting Device>

The connecting device **400** is now described. The connecting device **400** is arranged movably between the container T and the containing portion **71** so that the toner conveying path can be formed. Further, the connecting device **400** can be brought into contact with and separated away from the shutter **4** in conjunction with the operation of mounting the container T. The connecting device **400** can prevent the toner from leaking through the discharge port of the container T during the toner discharging operation. The above-mentioned operation of the connecting device **400** is described in detail below.

FIGS. **9**A-b and **10**A-b respectively correspond to a top view and a sectional view during the movement of the claw **30***a*. In FIGS. **9**A-b and **10**A-b, the state of the connecting device **400** is transitioning from the separated state to the connected (contact) state with respect to the container T.

The operation of the connecting device **400** is now described. The connecting device **400** that is a "connecting unit" includes: a connecting pipe **401** serving as a connecting member; the lifting member **402** fitted over the connecting pipe **401**; and a separating spring **403** which biases the connecting pipe **401** upward in FIGS. **10**A, **10**A-b, **10**B, and **10**C. The connecting device **400** further includes: lifting springs **404** which bias the lifting member **402** downward in FIGS. **10**A, **10**A-b, **10**B, and **10**C; and a connecting seal **405** having flexibility to form the opening Ma and arranged on the connecting pipe **401**. The connecting seal **405** is arranged to be brought into abutment against the shutter **4** so as to be elastically deformable when the connecting pipe **401** is connected to the shutter **4**. In this manner, the connecting seal **405** can seal a periphery of the communicating port **4***a*.

A regulating portion **401***a* provided to the connecting pipe **401** is brought into engagement with a claw **30***d* as a second locking portion arranged to the slider **30** of the release device **300**. In the state illustrated in FIG. **10**A, movement of the connecting pipe **401** in a direction indicated by an arrow Z**1** illustrated in FIG. **10**A-b is regulated. At this time, the connecting seal **405** and the shutter **4** for the container T are not connected to each other. A profile of the lifting member **402** is placed inside the containing portion **71** and is liftably sealed (the connecting device **400** in a first

position N1). Further, lifting projections **402***a* provided to the lifting member **402** allow the lifting member **402** to be moved up and down in a vertical direction illustrated in FIGS. **10**A, **10**A-b, **10**B, and **10**C along the lifting groove **21***k* provided to the flange portion **21** of the container T, as illustrated in FIG. **14**. The lifting groove **21***k* is also provided on an opposed side (not shown) in the same shape to guide the lifting projection **402***a*. The relationship between the lifting groove **21***k* and the lifting projection **402***a* is described in detail later.

When the connecting device **400** is in the first position N1 (FIG. **10**A), the shutter **4** arranged to the container T and the connecting seal **405** are not connected to each other and have a predetermined interval therebetween. Therefore, in a state in which the container T and the apparatus main body **200**A are packed in the same package, the containing portion **71** is kept at the atmospheric pressure even during transportation.

At this time, the closed region is on the downstream side of the containing portion **71**. Therefore, only the opening Ma provided on the connecting seal **405** communicates with the atmosphere.

When the release device **300** moves from the state illustrated in FIGS. **9**A and **10**A to the state illustrated in FIGS. **9**A-b and **10**A-b, the claw **30***d* is disengaged from the regulating portion **401***a* to move the regulating portion **401***a* in the direction indicated by the arrow Z1. The connecting pipe **401** is pressurized by the separating spring **403**. Therefore, the connecting seal **405** arranged to the connecting pipe **401** is biased until the connecting seal **405** abuts against the shutter **4** for the container T to be brought into close contact therewith.

In the state illustrated in FIGS. **9**B and **10**B (the connecting portion **400** is in a second position N2), the shutter **4** and the connecting seal **405** are brought into close contact with each other, and the communicating port **4***a*, the opening Ma, and the discharge port **21***a* are aligned coaxially with each other. At this time, the communicating port **4***a* can communicate with the discharge port **21***a* of the container T.

The claw **30***d* as the second locking portion is movable from the first position N1 (FIG. **10**A) to the second position N2 (FIG. **10**B). Specifically, the claw **30***d* can be located in the position (first position N1) in which the connecting pipe **401** is prevented from being connected to the shutter **4** in a state in which the container T is mounted to the main body. Further, the claw **30***d* can also be located in the position (second position N2) in which the connecting pipe **401** is not prevented from being connected to the shutter **4** in the state in which the container T is mounted in the main body.

<Operation of Bringing Communicating Port of Shutter and Toner Container into Communication>

An operation performed until the communicating port **4***a* provided to the shutter **4**, the opening Ma provided to the holding member TM, and the discharge port **21***a* of the container T are aligned is described below with reference to FIGS. **12**A, **12**B, and **12**C.

A positional relationship between the discharge port **21***a* formed in the flange portion **21** of the container T and the communicating port **4***a* provided in the shutter **4** is described below with reference to FIGS. **12**A, **12**B, and **12**C.

As illustrated in FIG. **12**A, the positional relationship between the communicating port **4***a* formed in the shutter **4** and the discharge port **21***a* formed in the flange portion **21** of the container T is set so that the communicating port **4***a* and the discharge port **21***a* are not aligned in a state in which the container T is not installed in the apparatus main body **200**A. Therefore, the shutter **4** seals the discharge port **21***a* so that the toner in the container T does not leak to the outside. At this time, the shutter **4** is located in a first position K1 that is a position of the shutter **4** before the container T is inserted into the apparatus main body **200**A of the image forming apparatus **200**.

FIG. **12**B illustrates the positional relationship between the communicating port **4***a* and the discharge port **21***a* at the time of transportation or shipping of the image forming apparatus **200**.

As a result of insertion of the container T into the apparatus main body **200**A, the shutter **4** reaches a set position (position in which the shutter **4** is locked to the stop portions **30***b*) in the container T on a rear side of the apparatus main body **200**A at the time when the container T is inserted to a given position. In FIGS. **12**A to **12**C, a direction indicated by an arrow JI is an inserting direction, whereas a direction indicated by an arrow J2 is a separating direction. In the set position, the locking portions **4***b* of the shutter **4** for the container T are brought into engagement with the stop portions **30***b* of the slider **30** of the release device **300** (engage as illustrated in FIG. **11**). At this time, the claw **30***a* of the slider **30** is locked by the fixing portion M1 provided to the holding member TM. Therefore, the movement of the slider **30** in the direction of insertion of the container T is regulated (see FIG. **8**A). When the container T is further inserted into the apparatus main body **200**A, the locking portions **4***b* of the shutter **4** slide in the direction indicated by an arrow S1 relative to the flange portion **21** by a predetermined amount so that the state transitions to a state illustrated in FIG. **12**B.

At the time of transportation or shipping of the image forming apparatus **200**, the container T is in the state illustrated in FIG. **12**B. At this time, the discharge port **21***a* and the communicating port **4***a* remain unaligned. Specifically, in a state in which the container T is mounted, the shutter **4** can be located in a non-communicating position in which the communicating port **4***a* and the discharge port **21***a* are not brought into communication with each other. Therefore, even at the time of transportation and shipping, the toner does not leak from the container T. FIGS. **7**A, **8**A, **9**A, and **10**A illustrate the state at this time. The discharge port **21***a* of the container T is aligned coaxially with the opening Ma that is provided to the holding member TM to form the path leading to the containing portion **71**. At this time, the shutter **4** is located in a second position K2 that is a position of the shutter **4** when the container T is mounted in the apparatus main body **200**A.

As illustrated in FIG. **14**, along with the insertion of the container T into the apparatus main body **200**A, the lifting projection **402***a* moves from a position Q1 along the lifting groove **21***k* by a distance Y1 (to a position Q2).

The lifting projection **402***a* remains in the position Q2 without moving therefrom even during the operation of releasing the sealing by the shutter **4**. FIGS. **9**A and **10**A illustrate a state of the connecting device **400** at this time.

<Release Device>

When the apparatus main body **200**A is installed, the release device **300** is operated to enable the toner to be discharged from the container T. Now, a specific configuration of the release device **300** is described. The release device **300** that is a "release unit" uses the driving force transmitted from the driving device D to the container T to release the sealing by the shutter **4**. As illustrated in FIGS. **9**A, **9**A-b, **9**B, **10**A, **10**A-b, **10**B, and **10**C, the release device **300** includes the slider **30** including the claw **30***a*, the stop portions **30***b*, and the restricting portions **30***c*, the two slide gears **44**, and the two worm gears **45**. The release device **300** is installed to the holding member TM.

The worm gears **45** are fixed to the slider **30** and move integrally with the slider **30** during the operation. The slide gears **44** are rotatable relative to the worm gears **45** and have such a relationship that the slide gears **44** are respectively fitted into the worm gears **45** so as to be coaxial therewith. When each of the slide gears **44** rotates, the corresponding worm gear **45** can be moved in a thrust direction of the slide gear **44** by a projection **46** (see FIG. **13**) provided on the inner side of the slide gear **44**. As illustrated in FIG. **7**A, the slide gear **44** is arranged in a position in which the slide gear **44** is meshed with the gear portion **20***a*.

As illustrated in FIG. **6**, the CPU **50** rotates the gear portion **20***a* to which the driving is input from the motor **80** for a predetermined time period based on the installation information. When the driving is transmitted to the slide gears **44**, the worm gears **45**, the slider **30**, and the claw **30***a* start moving. In the middle of the movement of the slider **30**, the claw **30***d* is disengaged from the regulating portion **401***a* as illustrated in FIGS. **9**A-b and **10**A-b. As a result, the connecting seal **405** is biased until the connecting seal **405** abuts against the shutter **4** for the container T to be brought into close contact therewith. From then on, the claw **30***d* is not brought into engagement with the regulating portion **401***a*.

When the projection **46** reaches a distal end of corresponding one of the worm gears **45**, the worm gear **45** terminates the predetermined amount of movement in the direction indicated by the arrow S**2**. At the same time, the claw **30***a* is moved to the fixing portion M**2** to be locked thereto (see FIG. **11**). Therefore, the movement of the slider **30** in the direction of insertion of the container T is regulated again.

Further, the restricting portions **30***c* abut against abutment portions M**3** (see FIG. **11**). Therefore, the movement of the slider **30** in the direction of removing the container T is also regulated. Specifically, the movement of the slider **30** is completely regulated. Thus, from then on, the slider **30** does not move even when the container T is inserted or removed, or the driving is input from the motor **80** (the slider **30** is located in a normal position).

The state at this time is illustrated in FIGS. **7**B, **8**B, **9**B, **10**B, **11**, and **12**C. In this step, the discharge port **21***a*, the communicating port **4***a*, and the opening Ma are aligned coaxially. A gear ratio of the gear portion **20***a* and each of the slide gears **44** is set so that the pump portion **20***b* performs an intake operation over a time period from the start of communication of the communicating port **4***a* of the shutter **4** to the completion of the communication. Specifically, during a process in which the discharge port **21***a*, the communicating port **4***a*, and the opening Ma are aligned coaxially, the toner does not flow into the containing portion **71**.

From then on, the toner can be supplied from the container T by operating the motor **80**. At this time, the shutter **4** is located in a third position K**3** (see FIG. **12**C) that the shutter **4** reaches as a result of driving of the driving device D, whereas the connecting device **400** is in the second position N**2** (see FIG. **10**B). The toner can be discharged when the shutter **4** is in the third position K**3** and the connecting device **400** is in the second position N**2**.

When the container T is removed from the apparatus main body **200**A, the connecting device **400** is located in a third position N**3** as illustrated in FIG. **10**C. The connecting pipe **401** is locked in a position at which the claw **401***b* abuts against the locking portion **402***b* of the lifting member **402** under the pressurization by the separating spring **403**, and moves up and down integrally as the connecting device **400**. At this time, as illustrated in FIG. **14**, the lifting projection **402***a* is also moved from the position Q**2** to the position Q**1** by the distance Y**1**. The connecting device **400** is maintained in the third position N**3** by the pressurizing force by the lifting springs **404**.

From then on, the connecting device **400** is maintained in the second position N**2** when the container T is installed. On the other hand, the connecting device **400** is maintained in the third position N**3** when the container T is removed, thereby dealing with the replacement of the container T.

As described above, the shutter **4** is movable between the first position K**1**, the second position K**2**, and the third position K**3**, and the connecting device **400** is movable between the first position N**1**, the second position N**2**, and the third position N**3**.

In this embodiment, the slider **30** is moved to the normal position to bring the communicating port **4***a* and the opening Ma into communication with each other. Therefore, after the slider **30** is moved to the normal position, the shutter **4** is opened and closed based on the mounting and removal of the container T.

Specifically, when the container T is not inserted into the apparatus main body **200**A, the shutter **4** in the state illustrated in FIG. **12**A is moved by a movement amount x1+x2 along with the insertion of the container T to be placed in the state illustrated in FIG. **12**C. As a result, the insertion is completed to enable the supply of the toner. (At this time, in a state in which the container is mounted, the shutter **4** can be located in the communicating position in which the communicating port **4***a* and the discharge port **21***a* are brought into communication with each other.) The release device **300** releases the sealing by the shutter **4** only when the driving device D is driven for the first time. The shutter **4** is mounted to the container T. When the container T is inserted into the apparatus main body **200**A of the image forming apparatus **200**, the shutter **4** is slid in the opposite direction (direction indicated by the arrow S**1** or direction indicated by the arrow S**2**) to the inserting direction (direction indicated by an arrow J**1**). Further, when the container T is separated away from the apparatus main body **200**A, the shutter **4** is slid in the opposite direction (direction opposite to the direction indicated by the arrow S**1** or the direction indicated by the arrow S**2**) to the separating direction (direction indicated by the arrow J**2**).

With the configuration of the embodiment described above, when the image forming apparatus **200** is not installed, the container T and the connecting device **400** are kept separated away from each other in a state in which the container T is mounted in the apparatus main body **200**A and packed in the same package. Therefore, a load is not applied to the connecting seal **405**. Therefore, when the container T and the connecting device **400** are connected to each other after the installation of the image forming apparatus **200**, poor connection due to deformation or damage of the connecting seal **405** is prevented. As a result, the toner can be prevented from spilling out.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2014-062358, filed Mar. 25, 2014, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An image forming apparatus comprising:

a bottle which is detachably attached to a mounting portion and which stores toner, the bottle having a discharge port from which the toner stored is discharged;

a shutter which is disposed on the bottle to open and close the discharge port, the shutter having a communicating port which is brought into communication with the discharge port; and

an engaging member which is movably disposed and configured to engage with the shutter, wherein, in a case that the engaging member is in an operating position, the engaging member engages with the shutter so as to open the discharge port by an attaching operation of the bottle into a set position, and wherein, in a case that the engaging member is in a non-operating position where the engaging member is retracted from the operating position, the shutter maintains a closed status of the discharge port when the bottle is attached at the set position;

a receiving device receiving the toner supplied from the bottle;

a connecting member which is displaceable between the bottle located at the set position and the receiving device, and is connectable to the shutter when the bottle is attached at the set position; and

a seal member which is compressed between the connecting member and the shutter to seal a periphery of the communicating port,

wherein, in a case that the bottle is located at the set position in a state that the engaging member is in the operating position, the connecting member is connected to the shutter, and

wherein, in a case that the bottle is located at the set position in a state that the engaging member is in the non-operating position, the connecting member is spaced apart from the shutter.

2. The image forming apparatus according to claim 1, further comprising:

a biasing member biasing the connecting member toward the shutter when the bottle is at the set position; and

a regulating portion which is provided in an apparatus main body and enables to regulate connection between the connecting member and the shutter,

wherein, in the case that the bottle is located at the set position in the state that the engaging member is in the operating position, the regulating portion permits the connecting member to connect to the shutter, and

wherein, in the case that the bottle is located at the set position in the state that the engaging member is in the non-operating position, the regulating portion regulates that the connecting member is connected to the shutter.

3. The image forming apparatus according to claim 2, further comprising a driving motor configured to drive the bottle, wherein the driving motor drives the engaging member and a regulating portion which is provided in an apparatus main body and enables to regulate connection between the connecting member and the shutter.

4. The image forming apparatus according to claim 3, wherein the engaging member and the regulating portion are configured integrally.

5. The image forming apparatus according to claim 1, wherein, when the engaging member is moved from the non-operating position to the operating position in a state that the bottle is located at the set position, the communicating port and the discharge port are brought into communication with each other after the connecting member is connected to the shutter.

6. The image forming apparatus according to claim 1, wherein, in a case that the engaging member is located in the operating position, the connecting member is connected to the shutter after the shutter is locked by the engaging member in conjunction with an operation of mounting the bottle, and the communicating port and the discharge port are brought into communication with each other after the connecting member is connected to the shutter.

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